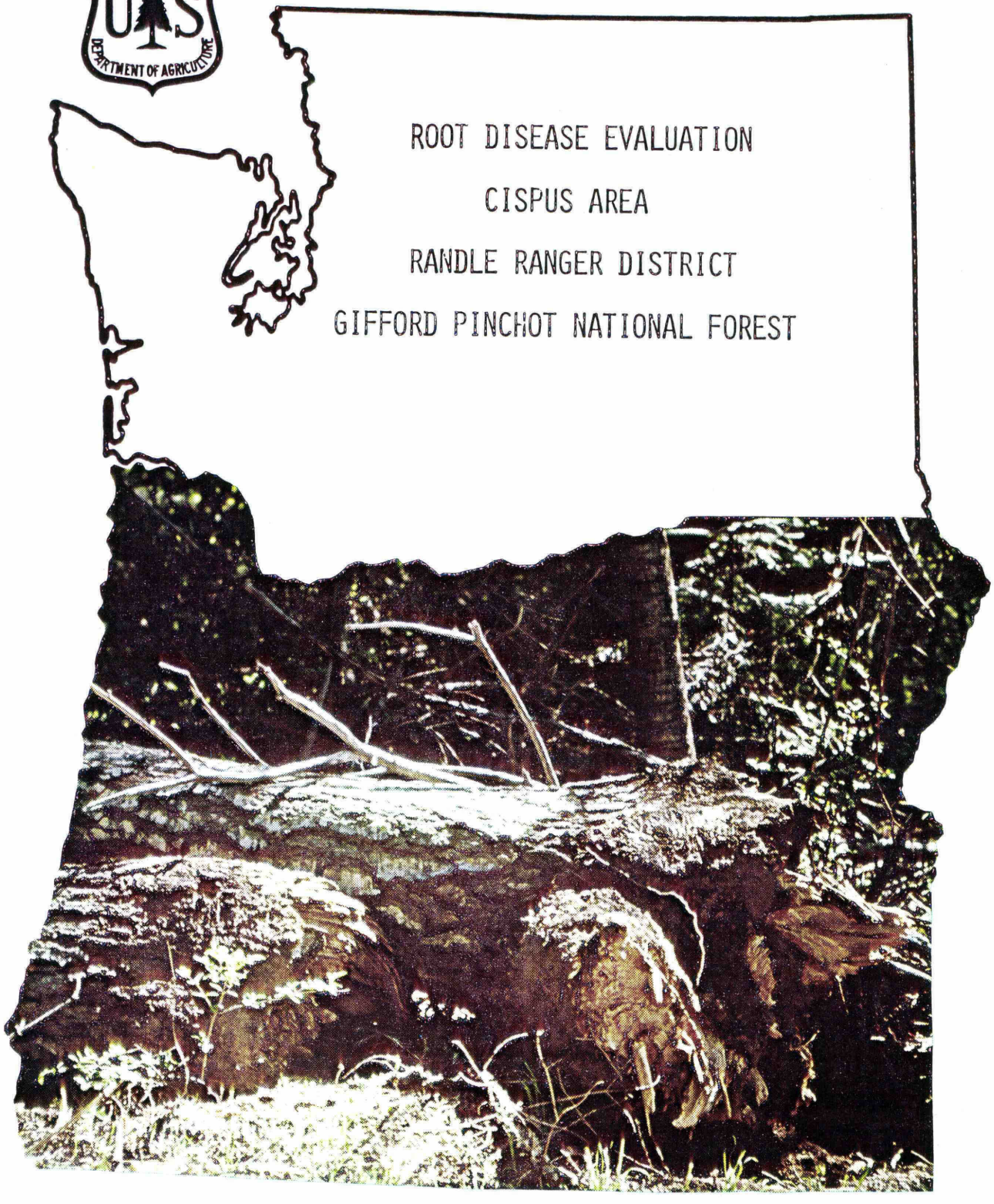
# Forest Pest Management
# Pacific Northwest Region

ROOT DISEASE EVALUATION

CISPUS AREA

RANDLE RANGER DISTRICT

GIFFORD PINCHOT NATIONAL FOREST



# ROOT DISEASE EVALUATION
# CISPUS AREA
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by

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## INTRODUCTION

On March 14-16, 1983, a Forest Pest Management crew did a root disease survey of a stand along the Cispus River (T. 11 N., R. 8 E., sec. 15 and 16), Randle Ranger District, Gifford Pinchot National Forest (Figure 1). A prescription will be written for this stand as a requirement for Silviculture Certification by Gary Wright of the District. As a result of observations in the area, Gary suspected a high incidence of root disease in this stand and requested a biological evaluation to determine distribution and intensity of damage and to provide pest management recommendations.

## METHODS

A systematic survey of the entire 240-acre block was accomplished by spacing variable radius plots (BAF=40) at 5-chain (330') intervals along transects located 5 chains apart. Each plot was inspected for dead, dying or symptomatic trees with root diseases. On plots containing such trees, the following data were recorded for all trees: species, diameter breast height (dbh), condition (dead or alive), and presence and identity of pathogen(s). Every fifth plot was a count plot in which all trees (including healthy) were tallied by species, dbh, and condition (live, dead, standing, down). From data collected in prism plots, mean basal area and number of trees per acre were calculated by species, dbh, condition and, where appropriate, cause of death or decline.

In addition to taking plot data, surveyors scrutinized the entire survey area for root diseases. This was done by reconnoitering a 2½-chain-wide strip on either side of the line. Root disease centers were mapped with boundaries based on the furthest extent of dead or symptomatic trees. This information was used to make a composite map of the area.

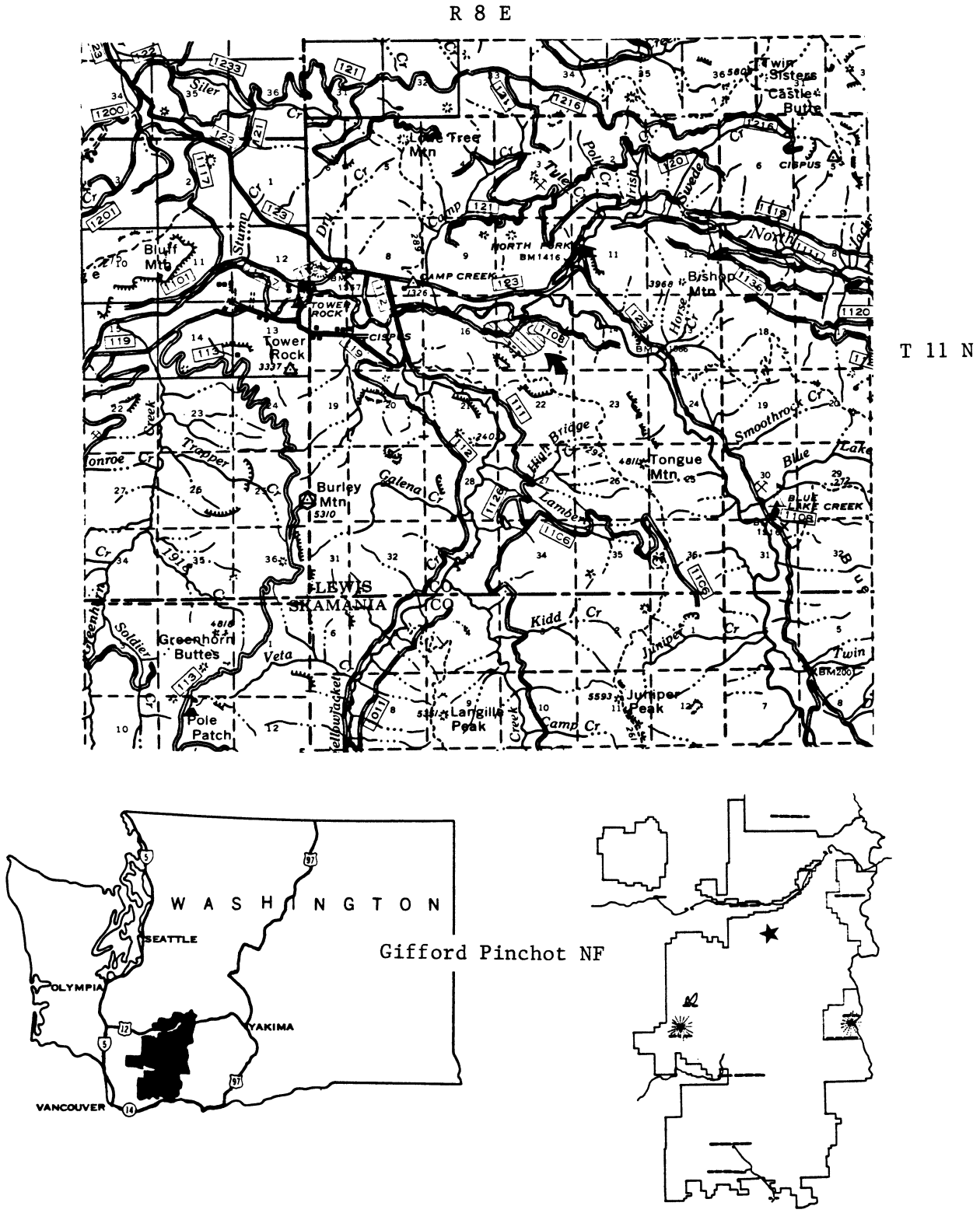


Figure 1. Maps depicting location of the Cispus Evaluation (cross-hatching and star), Randle Ranger District, Gifford Pinchot National Forest.

## RESULTS AND DISCUSSION

The survey revealed extensive losses to root diseases in the Cispus Block. Laminated root rot, caused by *Phellinus weirii*, was the most common disease present. Damage occurring as mortality and understocking within root rot centers was found throughout most of the stand. Scattered mortality due to Armillaria root rot, caused by *Armillaria mellea*, was also found across most of the survey area.

Approximately 35 percent of the stand area is affected by root disease (Figure 2). This high level of disease should be considered when formulating management plans for the stand.

Site quality in the Cispus Block is uniformly good. Soils are very porous, containing a large proportion of volcanic tuff. Slope on the site is gentle to moderate (10-30%) over much of the area but grades to 60% on the west and southern edges of the block. A single age class stand is present as a result of the 1918 Cispus Burn. The area naturally regenerated to essentially pure Douglas-fir (*Pseudotsuga menziesii*) which is now about 60 years old. Some red alder (*Alnus rubra*) is present and occurs in openings and wet areas understocked with fir. Evidence of later successional species such as western hemlock (*Tsuga heterophylla*) and western redcedar (*Thuja plicata*) were indicated by the presence of old snags and young saplings, but they do not currently make up an appreciable part of the main stand.

A stand of identical composition and history outside of and adjacent to the survey block was commercially thinned approximately 10 years ago. The stand in the survey block, however, has never been entered.

Only Douglas-firs were identified on cruise plots. Mean basal areas and trees per acre by condition and diameter class are shown in Table 1. Of the totals, 21.8 percent and 14.0 percent, stems and basal area per acre, respectively, are dead trees. Live infected trees with laminated root rot made up 10.5 percent of the total trees and 10.3 percent of the total basal area. Dead, laminated root rot-infected trees made up 14.8 and 10.3 percent of the trees and basal area, respectively.

Armillaria root rot was found on 0.75 percent of the total living basal area and 0.52 percent of the living trees. Of dead trees 3.3 percent of the total basal area and 6.4 percent of the trees, respectively, were affected by Armillaria root rot.

## DISEASE BIOLOGY AND IDENTIFICATION

### Laminated Root Rot

Laminated root rot is a common disease in Pacific Northwest stands. It primarily causes tree mortality and continuing loss of productivity within disease centers. Growth loss of infected trees also occurs.

Variability in species susceptibility exists in western Washington mixed-conifer stands. The most susceptible species is Douglas-fir, western hemlock is intermediately susceptible, western white pine is tolerant, western redcedar is resistant, and all hardwood species are immune.

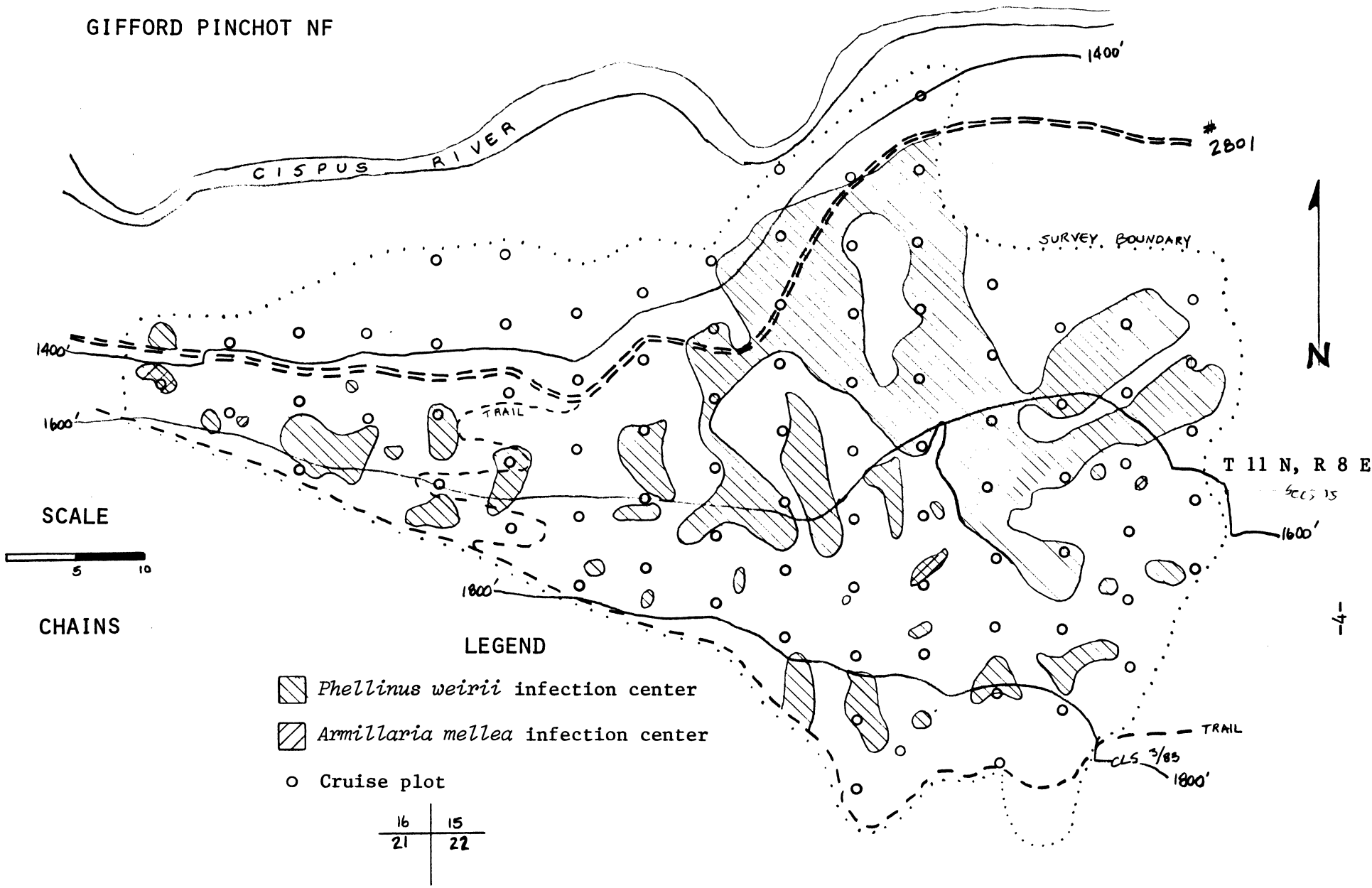


Figure 2. Distribution of root disease in the Cispus Survey Block, Randle RD, Gifford Pinchot NF.

Laminated root rot can be identified from a variety of signs and symptoms. The disease usually causes patches or groups of dead and dying trees in pole-size or larger stands. In the middle of disease centers, evidence of pest-killed, windthrown trees can usually be found. Examination of these trees will usually show the remnants of a decayed root system, termed a "rootball" (Plate 1). Exposed decayed wood will usually exhibit characteristic delaminations along the annual rings, pitting, and growth of reddish-brown setal hyphae between the sheets of decayed wood (Plate 2).

Around the periphery of disease centers, dying and some standing dead trees may be found. Dying trees may be recognized by several crown symptoms. Most obvious is sparse foliage due to minimal leaf growth in recent years. Other easily recognized conditions are off-color or chlorotic foliage and the production of a "distress" cone crop. A common disease symptom in small sawlog and larger-sized trees is a rounded crown. This results from minimal vertical growth in the last few years. Crown symptoms usually start to appear when 50 percent of the root system is colonized by the pathogen.

Examination of roots of diseased trees will often reveal ectotrophic mycelia, a white-to-tawny-colored fungal growth that grows on the outer surface of infected roots (Plate 3). On larger roots of older trees, this mycelium usually can be found in bark crevices.

*P. weirii* survives as a saprophyte for many years on dead host material (large roots and stumps). New infections occur when roots of healthy susceptible trees contact this material. Centers develop when the pathogen grows from diseased trees and infects healthy trees via root contacts or grafts. Laminated root rot thus remains on the site and infects subsequent generations as their roots contact those of old dead trees.

Disease centers expand as more trees become infected. The rate of expansion can be as much as 1 to 2 feet per year. Rates of expansion will be highest in stands fully stocked with only susceptible species.

Armillaria Root Rot

Armillaria root rot is found throughout the Northwest on a variety of hosts. In western Washington, this disease most commonly is found in plantations, especially where offsite stock was planted or local stock was poorly planted. Stressed trees of most species and all age classes are susceptible to attack. Douglas-fir is most susceptible when it is less than 30 years old. Occasionally, virulent strains of this fungus cause death of vigorous trees.

*A. mellea* damage is usually confined to single trees and small groups of trees. Disease spread also occurs across root contacts or grafts. Infective string-like fungal structures called rhizomorphs can spread the fungus a short distance through the soil.

Crown symptoms caused by Armillaria root rot include chlorotic foliage and/or a distress cone crop. Resinosis around the base of the bole is very common. Cream-colored mycelial fans are usually found growing under the bark of the lower bole on the root collar and roots of infected trees (Plate 4). These can also be found on trees that have been dead for up to 3 years. The presence of rhizomorphs is also diagnostic.

## MANAGEMENT ALTERNATIVES

Laminated root rot is causing severe losses in the survey block. Damage is occurring as mortality and growth loss. Large portions of the stand are understocked due to losses. Armillaria root rot has also caused some mortality in single tree to small group centers. Losses due to Armillaria root rot appear to be diminishing. While losses to *A. mellea* have been significant, they have not caused the pattern of loss that will result in a major reduction in final harvest volume. A large portion of the mortality is in single, widely spaced trees of the type that would be lost in normal stand succession.

The following management alternatives and their implications are formulated for the Cispus Block based on disease, stand, and site characteristics.

### *Defer Treatment/No Action*

Timber losses caused by laminated root rot have been substantial and will continue into the future. Trees will continue to become infected. However, mortality rates among newly infected trees will probably be lower. This is because it takes longer for larger trees to be affected and they may not succumb for many years. When the current stand is harvested, a large amount of infected material will remain on the site. The site will definitely have a higher level of inoculum than it does now. Prior to regenerating the site, the condition will have to be dealt with to avoid unacceptable losses in the future stand.

### *Stand Harvest*

#### Intermediate Harvest

As previously mentioned, a portion of the adjacent stand outside the survey boundary, also infected with laminated root rot, was treated with a partial removal harvest approximately 8 years ago. Observations made while in the area support our general recommendation of not thinning or partial cutting stands heavily infected with *P. weirii*. Infected residuals are more prone to windthrow and lateral spread rates of disease usually increase following thinning. Similar results can be expected in the survey unit if an intermediate thinning is done. Upon final harvest, the site will be at least as infected, if not more, than if no intermediate harvest had been done. There will be a more serious disease problem than currently exists and it will be more expensive and cause potentially more adverse impact than if treated immediately.

#### Clearcut Harvest and Disease Management Options

Clearcutting sections of the stand would allow the use of any of several root rot management tools currently recommended for minimizing future losses. Laminated root rot can be most effectively treated prior to stand reestablishment.

Where root disease centers can be totally enclosed with cutting units, boundaries of disease centers should be identified on the ground prior to logging and immediately after felling. For about 3 to 4 weeks after exposure, a crescent-shaped, red-brown stain usually is present on cut surfaces of infected stumps. Treatment area should extend 50' beyond the last symptomatic tree or stump in a center.

Plate 1. A windthrown Douglas-fir with decayed roots or "root-ball", caused by *Phellinus weirii*.

Plate 2. Laminated decay and setal hyphae characteristic of *Phellinus weirii*.

Plate 3. Ectotrophic mycelia of *Phellinus weirii* on Douglas-fir roots

Plate 4. Mycelial fans characteristic of *Armillaria mellea*

Regenerating less suceptible species within disease centers will minimize future losses. Planting IMMUNE--bigleaf maple (*Acer macrophyllum*), red alder (*Alnus rubra*); RESISTANT--western redcedar; or TOLERANT--western white pine (*Pinus monticola*), will minimize future losses and perpetuation of infective material in the soil. Following at least a 50-year rotation of such species, especially alder or maple, Douglas-fir could be safety replanted. Western hemlock, a species intermediately susceptible to *P. weirii*, can be grown in disease centers with minimal loss over a rotation; however, some trees may become infected and the disease will be carried over to the subsequent generation.

An alternative to species manipulation as a disease control would be inoculum removal. Removal of infected stumps can be accomplished with heavy equipment. Possible soil disturbance and compaction, soil nutrient drain, and steep topography are drawbacks to stump removal. However, soils found on the survey site would probably allow stump removal with minimal impact due to their granular, volcanic origin.

The use of fumigants directly applied to infected stumps has been used on an experimental basis. Stump fumigation avoids most of the disadvantages of stump removal; however, it will be expensive and it may have other unknown disadvantages since the system is still experimental.

## SPECIFIC MANAGEMENT RECOMMENDATIONS

The high incidence of root diseases in the survey area should receive management action. We recommend entering this stand in the next few years and locating clearcutting units to include root disease areas. The stand in the northeast portion of the survey block is most heavily infected with laminated root rot. The topography and slope in this area is also favorable for stump removal. The root disease areas in the western section of the surveyed stand are on steeper ground (40-60% slope) and would best be treated by regenerating less susceptible species such as redcedar, white pine, or western hemlock.

Clearcut size(s) should be large enough to include the greatest concentrations of root rot. Unit size(s) may have to be limited by other resource considerations and/or Regional guidelines. The opportunity exists to use more than one method to lesson future losses.

Table 1--Mean Basal Area ($ft.^2$) and Stems Per Acre (Douglas-fir) by Diameter Class and Tree Condition, Cispus Block.

| DBH Class | ALIVE | | DEAD | |
|---|---|---|---|---|
| | BA | TA | BA | TA |
| 2 | | | | |
| 4 | | | | |
| 6 | 5 | 25.5 | 1.9 | 9.5 |
| 8 | 2 | 7.2 | 5.1 | 14.7 |
| 10 | 30 | 38.2 | 6.5 | 11.9 |
| 12 | 25 | 31.8 | 7.0 | 8.9 |
| 14 | 25 | 23.4 | 3.3 | 3.0 |
| 16 | 35 | 25.1 | 1.4 | 1.0 |
| 18 | 25 | 14.1 | 2.8 | 1.6 |
| 20 | 15 | 6.9 | - | - |
| 22 | 7.5 | 1.8 | - | - |
| 24 | 2.5 | 0.8 | - | - |
| Total | 172.0 | 175.8 | 28.0 | 50.6 |

Table 2--Mean Basal Area (ft.$^2$) and Trees per Acre by Pest, Condition and Diameter Class, Cispus Block

| DBH Class | LIVING TREES WITH: *Phellinus weirii* BA | TA | *Armillaria mellea* BA | TA | DEAD TREES WITH *Phellinus weirii* BA | TA | *Armillaria mellea* BA | TA |
|---|---|---|---|---|---|---|---|---|
| 2 | | | | | | | | |
| 4 | | | | | | | | |
| 6 | 0.9 | 4.7 | | | 0.5 | 2.4 | 1.4 | 7.1 |
| 8 | 0.0 | 0.0 | | | 4.2 | 12.0 | 0.5 | 1.3 |
| 10 | 2.3 | 4.3 | | | 4.2 | 7.7 | 2.3 | 4.3 |
| 12 | 5.1 | 6.5 | 0.5 | 0.6 | 6.5 | 8.3 | 0.5 | 0.6 |
| 14 | 4.7 | 4.4 | | | 1.9 | 1.7 | 1.4 | 1.3 |
| 16 | 2.8 | 2.0 | 0.5 | 0.3 | 1.4 | 1.0 | | |
| 18 | 2.3 | 1.3 | 0.5 | 0.3 | 1.9 | 1.1 | 0.5 | 0.3 |
| 20 | 1.9 | 0.9 | | | | | | |
| 22 | 0.5 | 0.2 | | | | | | |
| 24 | | | | | | | | |
| 26 | | | | | | | | |
| Total | 20.5 | 24.3 | 1.5 | 1.2 | 20.6 | 34.2 | 6.6 | 14.9 |

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